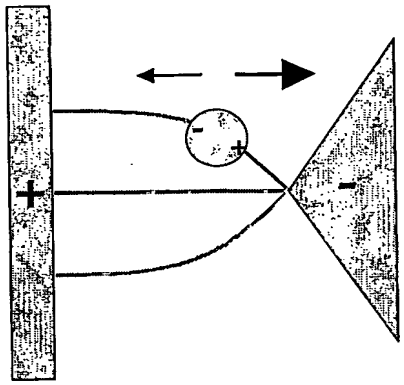
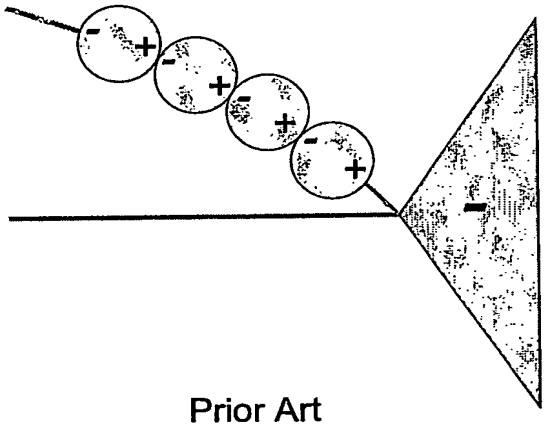
Non Uniform Field Movement



Prior Art

FIG. 1



Prior Art

FIG. 2

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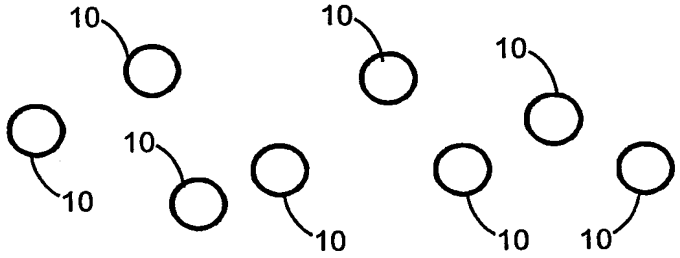


FIG. 3

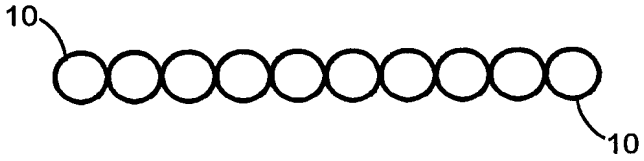


FIG. 4

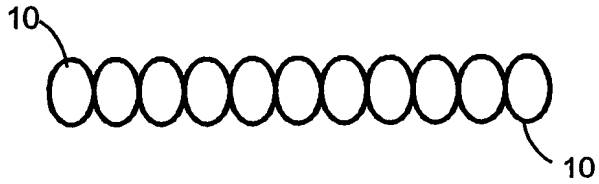
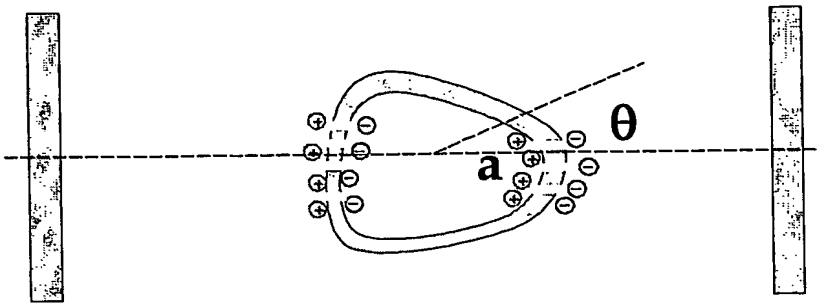


FIG. 5



Transmembrane voltage due to Electric field

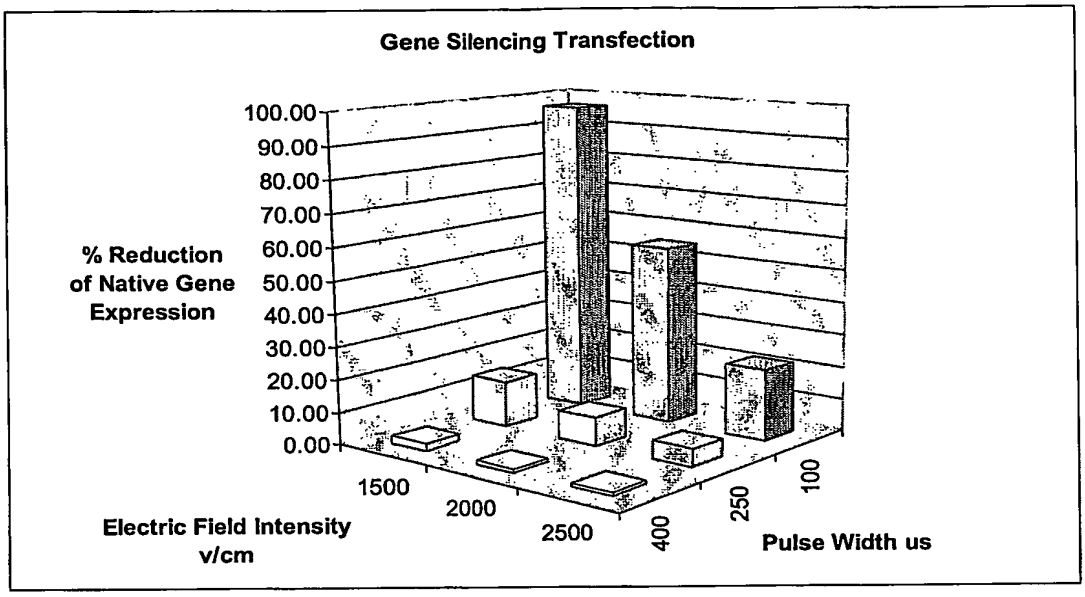
$$Vm = -1.5a|\cos(\theta)|\mathrm{E}$$

For coaxial Electrode

$$E = -\frac{V}{r_1 \ln(r_1 / r_2)}$$

Prior ART

FIG. 6



PA-4000 Cyto Pulse Sciences Electroporation System
Cytofusion, 80 µS/cm medium
2 mm cuvette
GAPDH siRNA
PC12 cells

FIG. 7

BEST AVAILABLE COPY

Force applied on a neutral particle by a nonlinear electric field

$$F_{dep} = a^3 [2\pi \varepsilon_{medium} K(\varepsilon, \sigma, \omega, r)] \nabla E^2$$

a = cell radius
ε = permittivity of medium external to the cell
K = Clausius-Mossotti Function, page 46, Jones
E = Electric field

For a coaxial chamber

$$\nabla E^2 = -\frac{2V^2}{r_1^3 \ln[(r_1/r_2)^2]}$$

FIG. 8

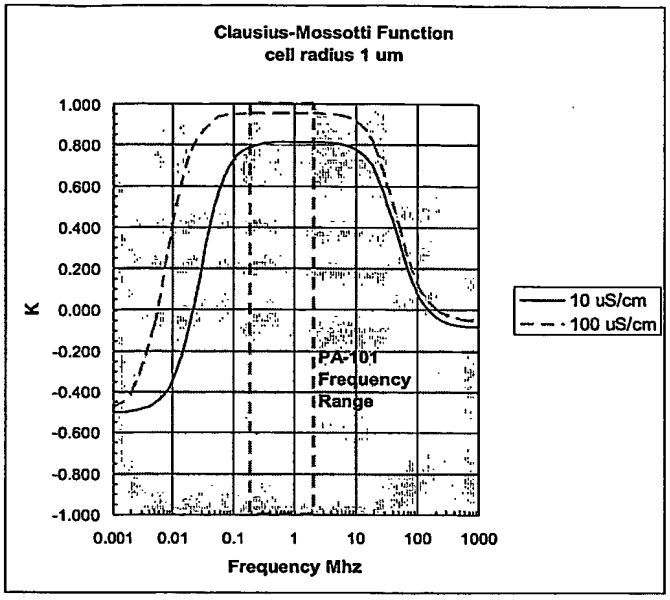


FIG. 9A

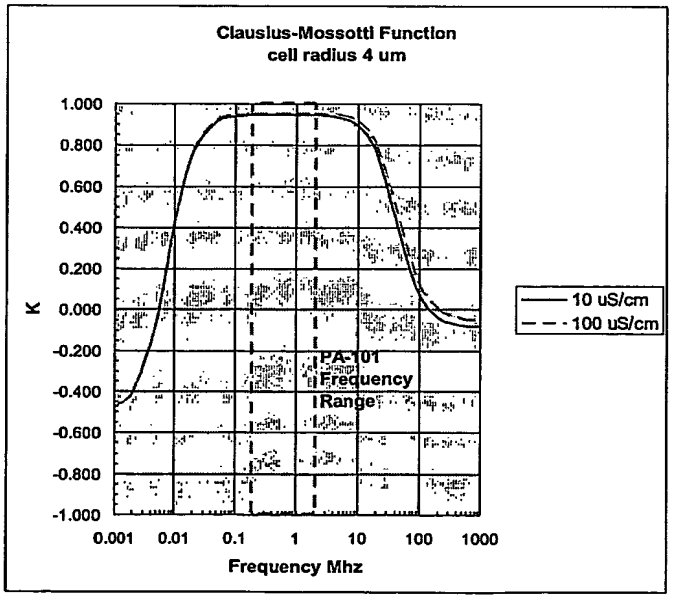
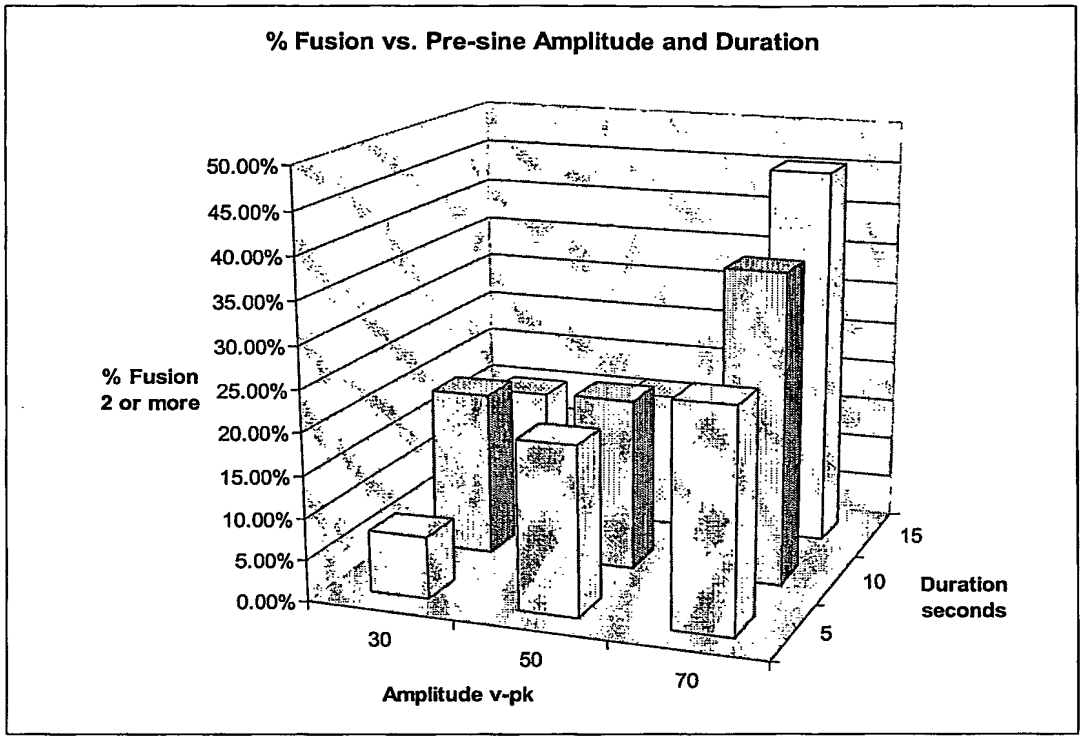


FIG. 9B

BEST AVAILABLE COPY



K562 Cells x K562 cells
Cyto Pulse PA-4000/PA-101 Electrofusion system
Cytofusion medium, 80 µS/cm
6 ml chamber (r1=19.5 mm, r2=23.5 mm, gap = 4 mm)

FIG. 10

BEST AVAILABLE COPY

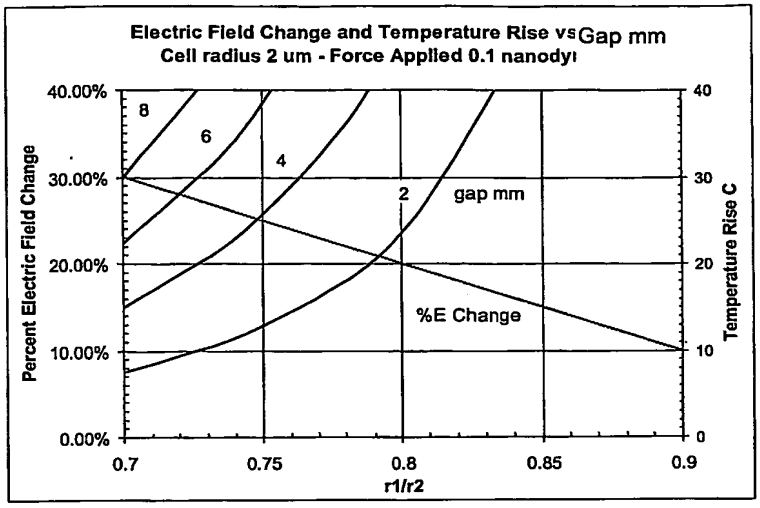


FIG. 11A

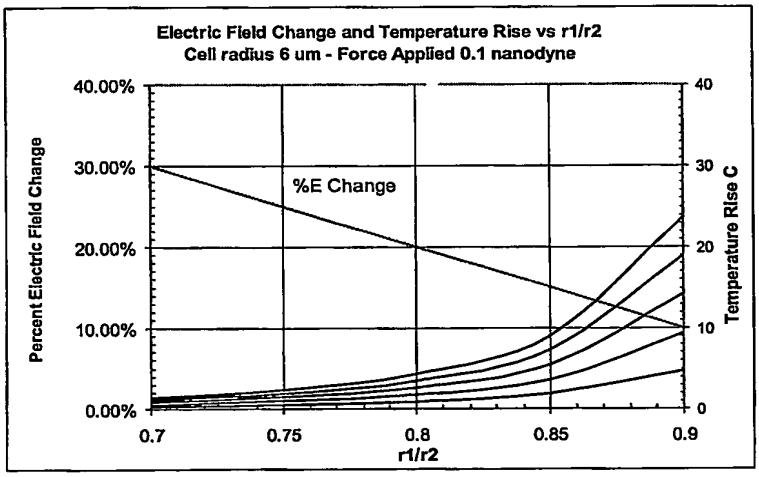


FIG. 11B

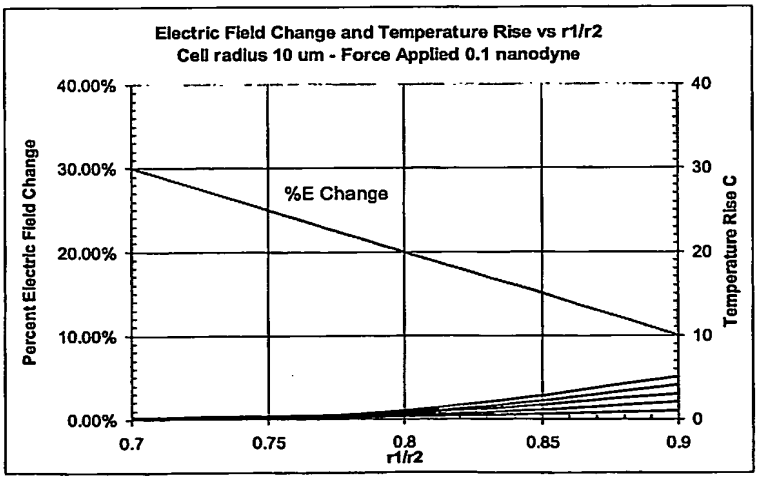


FIG. 11C

BEST AVAILABLE COPY

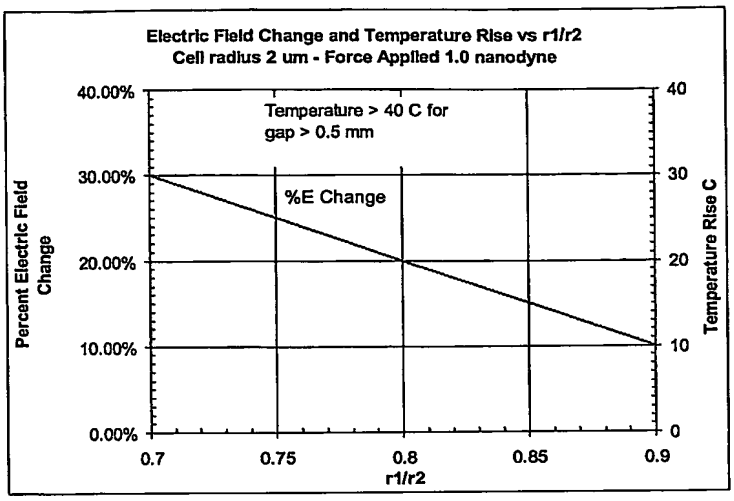


FIG. 12A

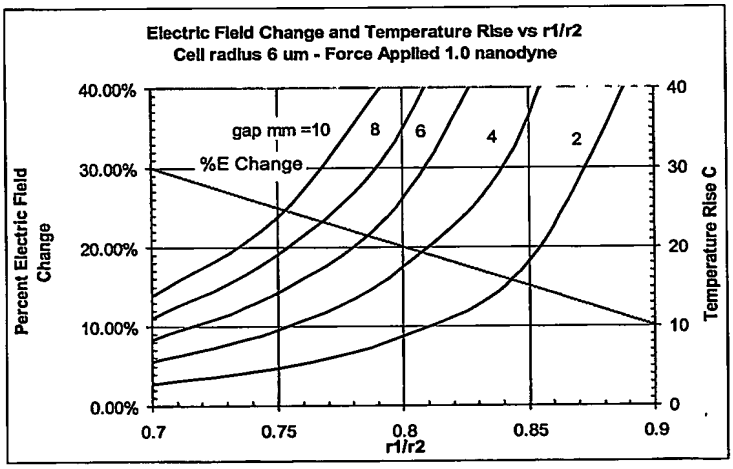


FIG. 12B

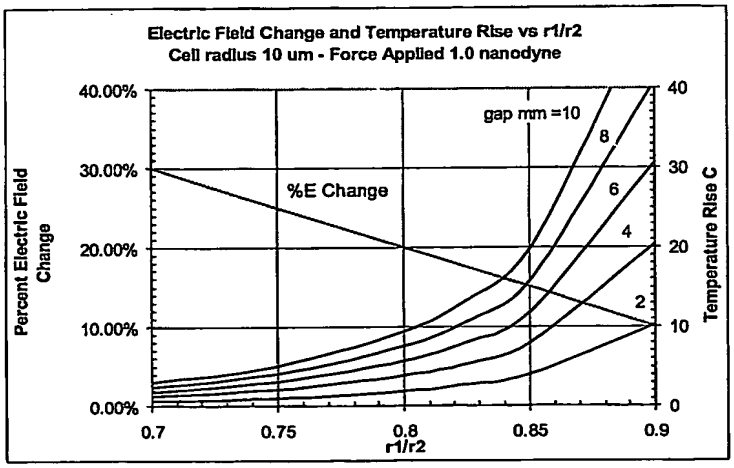


FIG. 12C

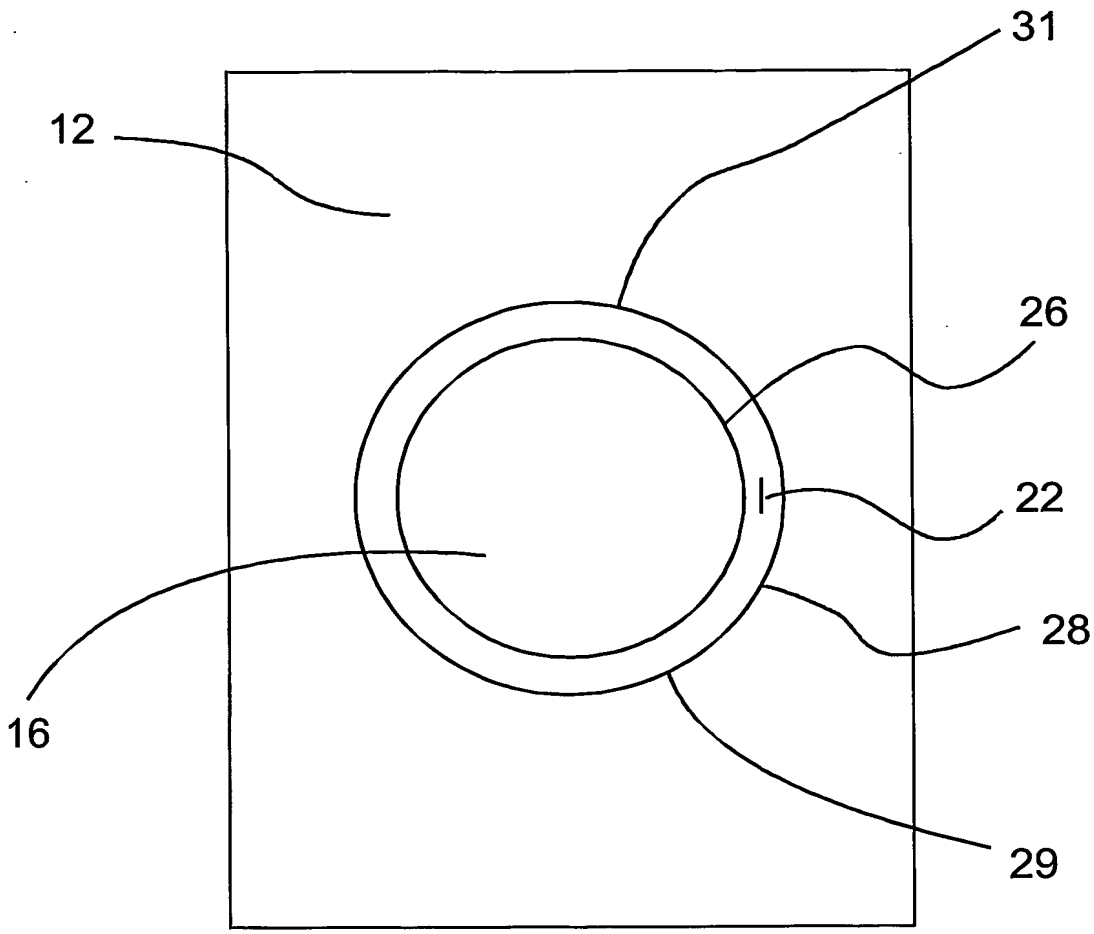


FIG. 13A

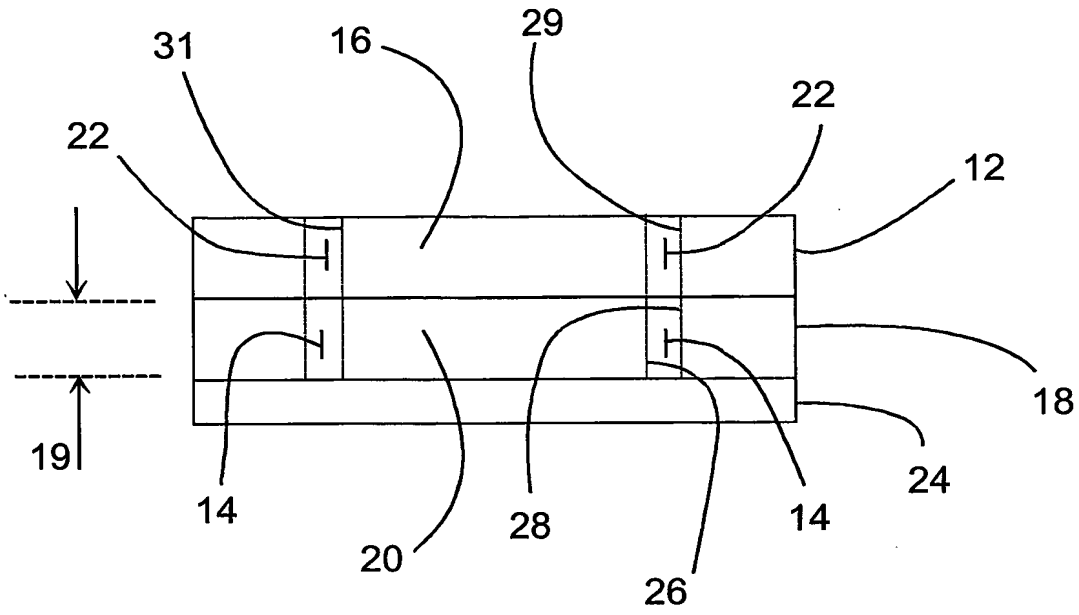


FIG. 13B

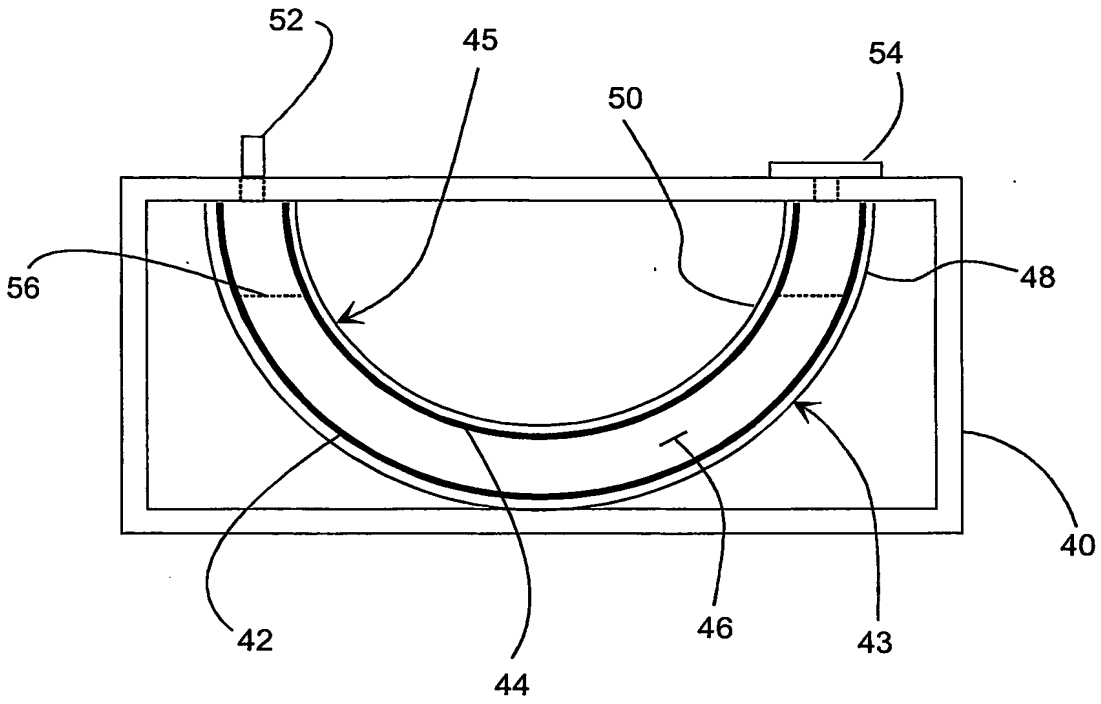


FIG. 14

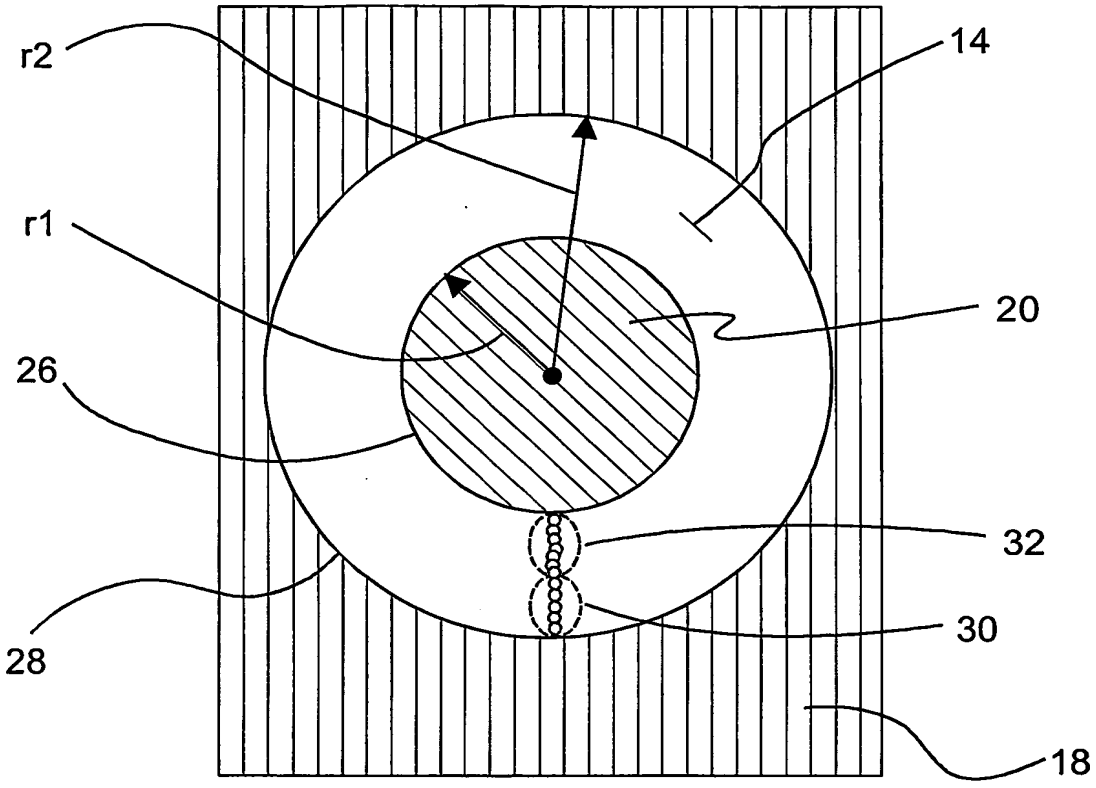


FIG. 15